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(54) Pulverized coal burner

(57) In pulverized coal burning boiler for generating steam for power generation or factory, a larger capacity of the burner can be achieved without increasing number of the burners attached to the boiler and without increasing the capacity per each of the burners. A pulverized coal mixture to be supplied in tangential direction with respect to imaginary circle in horizontal plane of furnace is made rich on centeral side of the imaginary circle by arranging a rich/lean separating body within the pulverized coal mixture nozzle, or dividing front end of the pulverized coal mixture vertically into upper and lower portions so as to introduce ignition promoting air between the nozzle front end and injecting outlet port, or biasing the pulverized coal mixture nozzle with respect to the air nozzle, thereby making it possible to enlarge the capacity of the pulverized coal burner.

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a pulverized coal burning boiler for generating a steam for a power plant, a factory and the like.

Description of the Prior Art

[0002] A conventional boiler of this kind will be described below with reference to Figs. 7 to 10.

[0003] Reference numeral 01 denotes a boiler furnace main body, and a plurality of burner main bodies 02 are disposed in a vertical direction at each of four corners therein. The burner main body 02 is constituted by a combustion air nozzle 03, an auxiliary air nozzle 04, a pulverized coal mixture nozzle 05, etc. and a pulverized coal mixture 10, a combustion air 11, a main burner air 12 and an additional air 13 are supplied thereto through a pulverized coal mixture feeding pipe 06, an air feeding duct 07, a main burner air duct 08 and an additional air duct 09.

[0004] Reference numeral 14 denotes an additional air nozzle disposed at an upper position, reference numeral 15 denotes a furnace, and a pulverized coal flame 16 is formed in the furnace 15. Reference numeral 17 denotes an air adjusting damper assembled in each of the burner main bodies 02, reference numeral 18 denotes an imaginary circle imagined in the furnace 15 for explanation purpose, and reference numeral 19 denotes a fire vortex formed in the furnace 15.

[0005] In the conventional pulverized coal burning boiler provided with the means mentioned above, a coal fed to a coal pulverizing apparatus (not shown) is finely pulverized, is mixed with a carrying air (a hot air) simultaneously fed so as to form the pulverized coal mixture 10, and is fed to the pulverized coal mixture nozzle 05 provided in the burner main body 02 through the pulverized coal mixture feeding pipe 06.

[0006] The burner main bodies 02 are provided at four corners of the boiler furnace main body 01, and plural sets of burners, each burner comprising the combustion air nozzle 03, the pulverized coal mixture nozzle 05 provided in a center portion thereof and the auxiliary air nozzle 04 provided above and below the combustion air nozzle 03, are installed within each of the burner main bodies 02. (Here, there is a case that the burner main bodies 02 are provided not only at four corners of the boiler furnace main body 01, but also on a wall surface as shown in Fig. 9.)

[0007] Each set of these nozzles, that is, the combustion air nozzle 03, the auxiliary air nozzle 04 and the pulverized coal mixture nozzle 05, is installed in such a manner as to blow the pulverized coal mixture 10 and the main burner air 12 in a tangential direction of an imaginary circle 18 which is set at a center portion on a horizontal cross section of the [redacted]urnace main body 01. A construction drawing of the conventional pulverized coal mixture nozzle 05 will be shown in Fig. 10.

[0008] The additional air nozzles 14 are provided at four corners above the burner main bodies 02 in the boiler furnace main body 01. The additional air nozzle 14 is installed in such a manner as to blow the additional air 13 in a tangential direction of an imaginary circle 18 which has a same diameter as that of the imaginary circle 18 with respect to the respective nozzles 03, 04 and 05 of the burner main body 02 and is set at a center portion on a horizontal cross section of the boiler furnace main body 01.

[0009] The pulverized coal mixture 10 supplied to the pulverized coal mixture nozzle 05 provided in the burner main body 02 is blown into the furnace 15 from the nozzle 05. On the other hand, the combustion air 11 is fed through the air feeding duct 07 by a feeding apparatus (not shown), and is branched into the main burner air 12 and the additional air 13 before entering the burner main body 02.

[0010] The main burner air 12 is fed to the burner main body 02 through the main burner air duct 08, and is blown into the furnace 15 from the combustion air nozzle 03 and the auxiliary air nozzle 04.

[0011] An amount of the main burner air 12 is generally set to be equal to or less than a stoichiometric mixture ratio of an amount of the pulverized coal blown as the pulverized coal mixture 10 so as to hold a portion of the furnace 15 below the additional air nozzle 14 in a reducing atmosphere, thereby reducing a nitrogen oxide (hereinafter referred to as to NOx for short) generated by burning the pulverized coal.

[0012] The main burner air 12 and the branched additional air 13 are fed to the additional air nozzle 14, and blown into the furnace 15 so as to be used for completing a burning of a combustible portion left in the combustion gas due to the reduction combustion.

[0013] The pulverized coal mixture 10 blown into the furnace 15 from the four corners of the boiler furnace main body 01 is ignited by an ignition source (not shown), and forms the pulverized coal flame 16. The pulverized coal flame 16 becomes a swirling flow so as to form the fire vortex 19, and ascend in the furnace 15 with swirling, thereby performing a swirling combustion.

[0014] As mentioned above, the amount of the main burner air 12 blown from the burner main body 02 is equal to or less than the stoichiometric mixture ratio of the amount of the pulverized coal blown as the pulverized coal mixture 10 from the pulverized coal mixture nozzle 05, so that the portion of the furnace 15 below the additional air nozzle 14 portion becomes a reducing atmosphere.

[0015] Accordingly, a combustion exhaust gas generated by burning the pulverized coal becomes to contain a combustible portion, however, NOx in the combustion exhaust gas generated by burning the pulverized coal is

reduced so that an intermediate product such as NH3 and HCN is generated in place thereof.

[0016] In the reduction of NOx in this reducing area, it is important to efficiently diffuse and mix the main burner air 12 and the pulverized coal mixture 10 so as to burn, and the more completely an oxygen supplied by the main burner air 12 is consumed, the higher a rate of NOx reduction becomes.

[0017] The combustion exhaust gas containing the combustible portion is blown with the additional air 13 in the additional air nozzle 14 portion, and the combustion thereof is completed till an outlet of the furnace.

[0018] In the conventional pulverized coal combustion mentioned above, in the case that a diameter of the imaginary circle 18 set in the center portion on the horizontal cross section of the boiler furnace main body 01 is excessively small, the pulverized coal flames 16 collide with each other, so that a formation of the fire vortex 19 becomes insufficient and the combustion is deteriorated. On the contrary, in the case that the diameter of the imaginary circle 18 is excessively large, the pulverized coal flames 16 collide with a side wall of the furnace 15 so that a phenomenon that a slagging occurs violently and a combustion is deteriorated is generated.

[0019] Accordingly, a determination of the diameter of the imaginary circle 18 has so far been carefully performed by taking actual results into consideration. Nevertheless, a negative pressure is generated between the side wall of the furnace 15 and the pulverized coal flame 16 by the main burner air 12 blown at a high speed, so that the fire vortex 19 formed by the pulverized coal flames 16 becomes a hollow doughnut-shaped fire vortex 19 having a diameter significantly larger than the diameter of the imaginary circle 18 and flows in the furnace 15 due to a so-called Coanda effect in which the pulverized coal flame 16 is drawn near the side wall. Therefore, the slagging occurs violently.

[0020] Since a blowing momentum of the pulverized coal mixture 10 blown from the pulverized coal mixture nozzle 05 becomes large when a capacity of the burner becomes large, a degree of collision of the pulverized coal flame 16 with side wall of the furnace 15 is increased, and in addition thereto, it becomes difficult to secure a stable ignitability. As a result, the conventional pulverized coal burner has a disadvantage that it is hard to increase the capacity.

[0021] In the case of intending to increase the capacity of the boiler, an combustion rate is necessarily increased, however, in order to deal with this, it is necessary (1) to increase a number of the burners attached to the boiler and (2) to increase the capacity of each of the burners.

[0022] Among them, the increase of the number of the burners is performed by increasing a number of stages of the burners since the number of the burners on the horizontal cross section of the boiler furnace main body 01 is fixed, however, in this manner, a height of the boiler is increased, so that a cost for constructing the boiler is increased.

[0023] Accordingly, in order to increase the capacity of the boiler, it is necessary to increase the capacity of each of the burners, however, when the combustion forming the fire vortex 19 is performed by the conventional burner, the blowing momentum of the pulverized coal mixture 10 blown from the pulverized coal mixture nozzle 05 is increased, together with an increase of the capacity of the burner, so that a degree of collision of the pulverized coal flame 16 with the side wall of the furnace 15 is increased. Therefore, there are problems that an amount of slagging is increased and it becomes difficult to secure the stability of ignition of the pulverized coal flame 16.

SUMMARY OF THE INVENTION

[0024] An object of the present invention is to solve the problems in the conventional one mentioned above, and to provide a pulverized coal burner structured such that a pulverized coal mixture is supplied in a tangential direction of an imaginary circle in a horizontal plane of a furnace so that a concentration of the pulverized coal mixture is made rich on a central side of the imaginary circle and it becomes possible to increase a capacity of the pulverized coal burner. This is attained by arranging a rich/lean separating body within the pulverized coal mixture nozzle, by separating a front end of the pulverized coal mixture nozzle into upper and lower portions and introducing an ignition promoting air between the front end of the pulverized coal mixture nozzle and an injection port, by shifting a center of the pulverized coal mixture nozzle to be eccentric with respect to an air nozzle, by swirling a combustion air, by adjusting a direction of a front end portion of the burner, etc.

[0025] Further, another object of the invention is to solve the problem in the prior art that the the entire furnace is heightened and the cost is increased, accompanying with a trial to provide the additional air port in the upper portion of the furnace so as to disperse the amount of air to reduce the amount of air in the burner windbox portion for reducing the value of NOx, and the problem that the thermal load of the burner portion becomes high and the slag (molten ash) is increasingly attached to the wall of the furnace so as to cause an obstruction in heat transmission and combustion, accompanying with a trial to reduce the height of the burner so as to restrict the height of the entire furnace, thereby providing a preferable burner portion having a high practicality.

[0026] The invention is made for achieving the objects mentioned above, and provides a pulverized coal burner for supplying a pulverized coal mixture in a tangential direction of an imaginary circle in a horizontal plane of a furnace so as to be burned, characterized in that a rich/lean separating body is arranged within a pulverized coal mixture nozzle so that the pulverized coal mixture becomes rich on a central side of the imaginary

circle. Accordingly, the pulverized coal mixture blown from the pulverized coal mixture [redacted] is blown such that an outer peripheral side of a [redacted] vortex formed in the central portion of the furnace is made lean and an inner portion side thereof is made rich, and a supply amount of a combustion air supplied from a combustion air nozzle, for example, provided on the outer periphery of the pulverized coal mixture nozzle is increased on the lean pulverized coal mixture side, thereby the pulverized coal flame is prevented from colliding with the wall surface of the furnace, so that a slagging is reduced and it becomes possible to make a capacity of the pulverized coal burner larger.

[0027] Further, the invention provides a pulverized coal burner, characterized in that a mixture injecting port of a front end of the pulverized coal mixture nozzle is divided into upper and lower portions and a means for introducing an ignition promoting air is provided between the divided injecting ports. Accordingly, an ignition stability of the pulverized coal flame is improved by dividing the pulverized coal mixture blown from the pulverized coal mixture nozzle into the upper and lower directions so as to reduce to half an amount of the pulverized coal mixture blown from one of the directions thereof and by blowing a high temperature combustion air between the pulverized coal mixtures flown from two directions, thereby making it possible to increase a capacity of the pulverized coal burner.

[0028] Still further, the invention provides a pulverized coal burner for supplying a pulverized coal mixture in a tangential direction of an imaginary circle in a horizontal plane of a furnace so as to be burned, characterized in that a pulverized coal mixture nozzle is made eccentric with respect to an air nozzle so that the pulverized coal mixture becomes rich on a central side of the imaginary circle. Accordingly, an axis of the pulverized coal mixture nozzle and an axis of the air nozzle are moved and shifted to be eccentric with each other so that a concentration of the pulverized coal of the pulverized coal mixture blown to an outer peripheral side of a fire vortex (near the wall surface of the furnace) formed in the furnace from the pulverized coal mixture nozzle is reduced and a concentration of the pulverized coal blown to an inner portion side of the fire vortex becomes rich, thereby the pulverized coal flame is prevented from colliding with the furnace wall and an amount of an air near the inner wall surface of the furnace is increased to form an oxidation atmosphere. Therefore, the molten ash is prevented from attaching by increasing an ash melting point.

[0029] Furthermore, the invention provides a pulverized coal burner, characterized in that a means for applying a swirl to a combustion air supplied from an outer periphery of the pulverized coal mixture nozzle is provided. Accordingly, an ignition stability with an increased capacity of a burner, a flame stability at a time of load changes, a short flame and a lowness of soot and dust can be secured by applying a swirl to the combustion air and by using, for example, a combined flame stabilizer, if necessary.

[0030] Moreover, the invention provides a pulverized coal burner, characterized in that a means for directing a front end portion of the burner in vertical and lateral directions is provided. Accordingly, a position of the fire vortex can be changed by making the structure capable of changing the nozzle direction in the vertical and lateral directions, so that a distribution of the thermal load in the furnace can be adjusted.

[0031] Further, the invention provides a pulverized burner characterized in comprising a burner having an increased width and a reduced height so as to effect in a high thermal load combustion of fuel in a narrow area, a separately provided additional air port disposed above the burner, a twist plate disposed within a pulverized fuel pipe for biasing a pulverized fuel to an inner side of the furnace and a combustion secondary air injection port for increasing an amount of air close to a furnace wall side by increasing an opening area close to the furnace wall side. Accordingly, the height of the burner is reduced in correspondence that the width of the burner is increased, thereby performing a high thermal load combustion for burning the fuel at the narrow area, the separately provided additional air port is arranged above the burner so as to reduce a generation of NOx in the burner portion, the twist plate disposed within the pulverized fuel pipe biases the pulverized fuel to the inner side of the furnace, and the opening area of the combustion secondary air injection port is increased in the portion close to the wall side of the furnace so as to increase the amount of the air close to the wall side of the furnace. Therefore, a melting point of the slag (the molten ash) is increased and the molten slag is prevented from attaching to the furnace wall in the high thermal load.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032]

Fig. 1 is an explanatory view as seen from a cross section along a line I-I in Fig. 2, which shows a system of a boiler in accordance with a first embodiment of the invention;

Fig. 2 is a cross sectional view along a line II-II in Fig. 1, which shows a horizontal cross section of the boiler in Fig. 1;

Figs. 3(a), 3(b) and 3(c) show a summary of a pulverized coal mixture nozzle in the boiler shown in Figs. 1 and 2, in which Fig. 3(a) is a schematic view showing a cross section along a line a-a in Fig. 3(b), Fig. 3(b) is a schematic view showing a cross section along a line b-b in Fig. 3(a) and Fig. 3(c) is a schematic view showing a cross section along a line c-c in Fig. 3(a);

Fig. 4 is a front elevational view of a burner in accordance with a second embodiment of the

invention;

Fig. 5 is a vertically cross sectional view of the burner shown in Fig. 4;

Figs. 6(a), 6(b), 6(c) and 6(d) show a summary of a pulverized coal burner in accordance with a third embodiment of the invention, in which Fig. 6(a) is a schematic view showing a cross section of a boiler. Fig. 6(b) is a schematic view showing a burner windbox arranged at four corners of Fig. 6(a) and a separately provided additional port arranged above the burner windbox, Fig. 6(c) is a schematic view showing a front surface of one of fuel nozzles of Fig. 6(b) and Fig. 6(d) is a schematic view showing a pulverized fuel pipe for supplying a fuel to a fuel nozzle of Fig. 6(c);

Fig. 7 is a schematic view as seen from a cross section along a line VI-VI in Fig. 8, which shows a system of a conventional boiler;

Fig. 8 is a cross sectional view along a line VII-VII of a boiler shown in Fig. 7;

Figs. 9(a), 9(b), 9(c) and 9(d) are schematic views which respectively show different aspects of an arrangement of a burner in the conventional boiler; and

Figs. 10(a) and 10(b) show a pulverized coal mixture nozzle in the conventional boiler, in which Fig. 10(a) is a cross sectional view and Fig. 10(b) is a cross sectional view along a line B-B of fig. 10(a).

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0033] A first embodiment of the invention will be described below with reference to Figs. 1 to 3. In this case, in correspondence to the conventional ones mentioned above, reference numerals obtained by adding 100 to the reference numerals in the conventional ones will be attached to the same parts so that a mutual relation can be easily understood, and an overlapping description will be omitted as much as possible.

[0034] Accordingly, since reference numerals 101 to 119 correspond to the reference numerals 01 to 19 in the conventional structure, a description will be simplified as much as possible, and an ignition promoting air hole 120 provided in a pulverized coal mixture nozzle 105, an ignition promoting air chamber 121, an ignition promoting air chamber inlet port 122, a guiding plate 123, a rich/lean separating body 124, etc. will be described in detail.

[0035] A coal fed to a coal pulverizing apparatus (not shown) is pulverized there, is mixed with a carrying air (a hot air) simultaneously fed so as to form a pulverized coal mixture 110, and is fed to a pulverized coal mixture nozzle 105 provided in a burner main body 102 through a pulverized coal mixture transporting pipe 106.

[0036] The pulverized coal mixture nozzle 105 is constituted by a pulverized coal mixture pipe connected to the pulverized coal mixture transporting pipe 106, and a mixture injecting nozzle attached to a front end thereof. The rich/lean separating body is provided within the pulverized coal mixture pipe near an inlet of the mixture injecting nozzle.

[0037] An injecting port of the mixture injecting nozzle is branched into upper and lower directions with an optional angle, for example, an angle of 10 degrees to 30 degrees in one direction with respect to a horizontal axis, and the ignition promoting air chamber 121 is provided between the upper and lower injecting ports.

[0038] The combustion air nozzle 103 is provided on an outer periphery of the mixture injecting nozzle, and blows the main burner air 112 into the furnace 114 from a blowing port constituted by the mixture injecting nozzle and the combustion air nozzle 103.

[0039] The pulverized coal mixture 110 fed to the pulverized coal mixture nozzle 105 flows in a biased manner at the pulverized coal mixture pipe outlet portion by the rich/lean separating body 124. As a result, the pulverized coal mixture 110 is structured such that a concentration of the pulverized coal becomes lean on the rich/lean separating body 124 attaching side at the mixture injecting nozzle outlet port due to a force of inertia and a concentration of the pulverized coal on the opposite side not attaching the same becomes rich.

[0040] A blowing port of the main burner air 112 formed by the mixture injecting nozzle and the combustion air nozzle 103 is formed wider on the lean pulverized coal side of the pulverized coal mixture 110 and narrower on the rich pulverized coal side.

[0041] In a swirling combustion performed by forming the fire vortex 119 in a center portion of the furnace 115, a portion, blown into a central side of the fire vortex 119, of the pulverized coal mixture 110 injected from the mixture injecting nozzle becomes to an upstream side of the swirling combustion flow, so that said portion is in a state of easily igniting having a large radiant heat from the adjacent pulverized coal flame 116. Accordingly, the pulverized coal mixture 110 is set such that the rich pulverized coal side is blown to the central side of the fire vortex 119.

[0042] In the main burner air 112 blown from the main burner air 112 blowing port formed by the mixture injecting nozzle and the combustion air nozzle 103, since an area of of the main burner air 112 blowing port is set such that a blowing amount to the central side of the fire vortex 119 becomes less and a blowing amount to the outer peripheral side (a wall surface side of the furnace) of the fire vortex 119 becomes more, the pulverized coal flame 116 is prevented from colliding with the wall surface of the furnace 115, thereby restricting a generation of slagging and unburned component.

[0043] In addition to the structure mentioned above, in accordance with this embodiment, a new device is further added to the mixture injecting nozzle in order to improve an ignition stability of the pulverized coal flame 116.

[0044] That is, as mentioned above, the mixture inject-

ing nozzle is structured such that the injecting port thereof is branched to the upper [redacted] lower directions with an optional angle, the ignition [redacted] moting air chamber 121 is provided between the upper and lower injecting ports, and the guiding plate 123 and the ignition promoting air chamber inlet hole 122 are provided in the inlet of said air chamber 121.

[0045] The ignition promoting air chamber 121 is formed by disposing a plate on a side facing to the the furnace 115, and the ignition promoting air hole 120 is bored on the plate so as to blow the main burner air 112, which has flown to the ignition promoting air chamber 121 through the ignition promoting air chamber inlet hole 122, between two pulverized coal mixtures 110 injected from the mixture injecting nozzle.

[0046] The main burner air 112 blown from the ignition promoting air hole 120 prevents flows of the pulverized coal mixture 110 blown from two injection ports of the mixture injecting nozzle from joining togehter earlier, and since a temperature of the main burner air 112 is high to be about 300 °C in comparison that a temperature of the pulverized coal mixture 110 is generally 100 °C or less (in many cases, about 80 °C), an effect that a generation of a volatile matter between the pulverized coal mixtures 110 is promoted can be obtained, so that an igniting stability of the pulverized coal flame 116 can be secured.

[0047] Next, a second embodiment in accordance with the invention will be described below with reference to Figs. 4 and 5. Here, in this embodiment, an explanation will be given with respect to a representative burner main body, and it will be easily understood that this respresentative burner main body is one that is picked up and shown from the burners arranged in the first embodiment.

[0048] Reference numeral 201 denotes a pulverized coal mixture nozzle, and a secondary air nozzle 202 and a tertiary air nozzle 203 are arranged in a periphery thereof.

[0049] Reference numeral 204 denotes a swirler, arranged at an upstream position of an outlet of the tertiary air nozzle 203. Reference numeral 205 denotes a hollow core provided at an upstream position of an outlet of the pulverized coal mixture nozzle 201.

[0050] Reference numeral 206 denotes a tilt bar connected to a spherical connecting portion 210 at a front end portion of each of the nozzles 201, 202 and 203, and each of the nozzles 201, 202 and 203 can be directed in a vertical direction around the connecting portion 210 by moving the tilt bar 206 laterally as shown by arrows in the drawing.

[0051] In this case, a tilt bar 206 connected to the tertiary air nozzle 203 operates a motion in the vertical direction of the tertiary air nozzle 203, and the pulverized coal mixture nozzle 201 and the secondary air nozzle 202 are interlocked by a supporting rod 207 and the tilt bar 206 is connected to the secondary air nozzle 202, thereby the pulverized coal mixture nozzle 201 together with the secondary air nozzle 202 change the direction in the vertical direction [redacted]

[0052] Further, it can be easily understood that another tilt, bar (not shown) is connected to a position substantially 90 degrees rotated in the spherical connecting portion 210, so that the front end of each of the nozzles 201, 202 and 203 can change the direction in the lateral direction. Further, reference numeral 208 denotes a flame stabilizer, arranged at the front end of each of the nozzles 201, 202 and 203, for serving a flame stabilizing effect.

[0053] Accordingly, in accordance with this embodiment, by the hollow core 205 within the pulverized coal mixture nozzle 201, a concentration distribution of the pulverized coal in the pulverized coal mixture injecting flow is made rich on the peripheral side, and by the flame stabilizer 208, an ignition stability is increased.

[0054] Further, the injecting direction of the pulverized coal mixture, the secondary air and the tertiary air can be changed in the vertical and lateral directions by moving the tilt bar 206 in the front and rear direction. In this case, since the pulverized coal mixture nozzle and the secondary air nozzle are interlocked to be fixed together by the supporting rod 107, the injecting flow therefrom is directed in the same direction.

[0055] A third embodiment in accordance with the invention will be described below with reference to Fig. 6. In this case, Fig. 6(a) shows a cross section of a boiler, Fig. 6(b) shows a burner windbox arranged at each of four corners of Fig. 6(a) and a separately provided additional air port arranged above the burner windbox, Fig. 6(c) shows a front of one of fuel nozzles of Fig. 6(b) and Fig. 6(d) shows a pulverized fuel pipe for supplying a fuel to the fuel nozzle of Fig. 6(c).

[0056] In Fig. 6(a), reference numeral 301 denotes a cross section of a furnace, a periphery of which is surrounded by a wall of the furnace in a square shape, and a burner windbox 302 is arranged at each of four corners thereof. Reference numeral 303 denotes a flame and reference numeral 304 denotes a section close to the furnace wall.

[0057] Fig. 6(b) shows a detail of the burner windbox 302 structured in five stages. That is, auxiliary air portions 305b and 305a are arranged at upper and lower ends, a first stage fuel nozzle portion 306a is placed on the lower end auxiliary air portion 305a, a second stage fuel nozzle portion 306b is placed thereon via an oil nozzle portion 307a, and a third stage fuel nozzle portion 306c, a fourth stage fuel nozzle portion 306d and a fifth stage fuel nozzle portion 306e are likewise placed via an oil nozzle portion 307b, an oil nozzle portion 307c and an oil nozzle portion 307d, respectively, up to the upper end auxiliary air portion 305b overlappedly with no gap being placed between each of them.

[0058] Then, among the elements in this overlapped body, paying attention to the hatched fifth stage fuel nozzle portion 306e, the front shape thereof is shown in Fig. 6(c). Then, the fifth stage fuel nozzle portion 306e

is constituted by a fuel injecting port 308, disposed in a central portion, for injecting a [redacted]ized fuel and a carrying air, and a combustion se[redacted]ary air injecting port 309, surrounding a periphery thereof, for injecting a secondary air.

[0059] As a matter of course, the other fuel nozzle portions 306a to 306d are also constituted in the same manner as that of the fifth stage fuel nozzle portion 306e. Further, the pulverized fuel and the carrying air to be injected from the fuel injecting port 308 are carried through the pulverized fuel pipe 310 shown in Fig. 6(d) and reach the fuel injecting port 308.

[0060] It is to be noted that a basic construction part has been described above, however, as will be understood from the description in Fig. 6, various kinds of devices are further added to the invention. That is, the furnace cross section 301, the periphery of which is surrounded by the furnace wall in a square shape, is provided with the burner windbox 302 at each of four corners, however, the first to fifth stage fuel nozzle portions 306a to 306e, which constitute a main portion of the burner disposed here, and the respective oil nozzle portions 307a to 307d disposed therebetween are structured with an elongated horizontal width and a reduced height.

[0061] For example, in the conventional general fuel nozzle portion, the horizontal width is made to be 1 to 1.5 times the height, however, in this embodiment, the shape is formed such that the horizontal width is made to be about three times the height, and the height is reduced corresponding to the horizontal width, so elongated, so that the total height of the five stages is made lower.

[0062] Then, an additional air port 314 is provided above the burner windbox 302 constructed in five stages overlappedly, and the position of the additional air port 314 is set to be substantially same as the height at which the uppermost element of the conventional general fuel nozzle portions is arranged.

[0063] Further, the hatched fifth stage fuel nozzle portion 306e in the overlapped body is structured such that the front shape is constituted, as shown in Fig. 1(c), by the fuel injecting port 308, arranged on the inner side, for injecting the pulverized fuel and the carrying air, and the combustion secondary air injecting port 309, surrounding the fuel injecting port 308, for injecting the secondary air, however, the fuel injecting port 308 on the inner side is biased rightward as seen in the drawing in the fuel secondary air injecting port 309, surrounding the fuel injecting port 308.

[0064] That is, the structure is such that an opening portion of the fuel secondary air injecting port 309 is broader in a portion close to the furnace wall and a portion close to the center is narrower by that degree, so that the combustion secondary air is injected more to the portion close to the furnace wall by increasing an air flow area in the portion close to the furnace wall, and a lean fuel flame 311 is formed within the section 304 close to the furnace wall on the furnace wall side of the flame 303 around the cente[redacted]

[0065] Further, in the interior of the pulverized fuel pipe 310 for supplying the pulverized fuel and the carrying air to the fuel injecting port 308, a block 313 is disposed at a portion at which a flow of the pulverized fuel and the carrying air curves, so that the pulverized fuel etc. is biased outwardly of the curved portion above the block by a centrifugal force and then, by use of a twist plate 312 which is arranged so as to twist a flow 90 degrees, the rich pulverized fuel etc. is biased to the inner side of the furnace and the concentration thereof in the portion close to the furnace wall is reduced.

[0066] Since the embodiment is structured in the manner mentioned above, the pulverized fuel flows with an increased area for receiving a radiation heat from the flame so as to promote the ignition by expanding the width of the so-called burner portion comprising the first to fifth stage fuel nozzle portions 306a to 306e and by reducing the height of the burner, and a combustion is done in a narrow area, thereby elevating an atmospheric temperature and improving a combustibility.

[0067] Further, the additional air port 314 installed separately from the burner portion is provided at the height position substantially corresponding to the uppermost stage of the conventional general burners and a sufficient amount of air corresponding to about 30 to 40 % of all the combustion air is supplied there, thereby making the burner portion a reducing area with a shortage of air, and further, reduction of the height of the entire burner portion secures a residence time for the pulverized fuel and the combustion gas moving from the burner portion to the additional air port 314, so that the NOx reducing area is further strengthened in addition to the promotion of ignition and the increase of the atmospheric temperature.

[0068] Further, the twist plate 312 and the block 313 disposed inside the pulverized fuel pipe 310 first bias the pulverized fuel within the cross section of the pulverized fuel pipe 310 by a centrifugal force due to the block 313 and the curve of the pulverized fuel pipe 310, and next the twist plate 312 twists the pulverized fuel in the rich area to be injected to the inner side of the furnace, and reduces the pulverized fuel amount near the furnace wall, so that amount of ash content is reduced also.

[0069] Still further, in case that an iron is contained in the ash, a compound having a low melting temperature is formed in a state that the peripheral atmosphere is short of air and a bonding force is increased, so that an air amount close to the furnace wall where the opening area is broad is increased, and such component is prevented from occurring with the sufficient air.

[0070] The embodiments of the invention are described above, however, the invention is not limited to the embodiments, and it is needless to say that various changes can be added to the concrete constructions within the scope of the invention.

[0071] As mentioned above, in accordance with the invention, by use of the rich/lean separating body disposed within the pulverized coal mixture nozzle, the concentration of the pulverized coal of the pulverized coal mixture blown into the furnace is made rich in the portion blowing to the central side of the fire vortex and lean in the portion blowing to the outer peripheral side, thereby preventing the pulverized coal flame from colliding with the wall surface of the furnace, and the slagging can be reduced and the capacity of the pulverized coal burner can be enlarged.

[0072] Further, in accordance with the invention as recited in Claim 2, by use of the ignition promoting air hole of the ignition promoting air chamber provided between the upper and lower injecting outlet ports at the front end of the pulverized coal mixture nozzle, a part of the high temperature main burner air is blown to the portion between the pulverized coal mixture injecting flows injected from the upper and lower injecting outlet ports, thereby preventing the upper and lower pulverized coal mixture injecting flows from being joined together earlier, and further, since the generation of the volatile matter is promoted, the pulverized coal flame can be stably ignited and burned, and the capacity of the pulverized coal burner can be enlarged.

[0073] Still further, in accordance with the invention as recited in Claim 3, the axis of the pulverized coal mixture nozzle and the axis of the air nozzle are shifted to be eccentric with each other so that the concentration of the pulverized coal in the pulverized coal mixture blown from the pulverized coal mixture nozzle to the portion on the outer peripheral side of the fire vortex formed in the furnace, that is, the portion close to the wall surface of the furnace is made lean and the concentration of the pulverized coal blown to the portion the inner side of the fire vortex is made rich, thereby the pulverized coal flame is prevented from colliding with the furnace wall and the air amount near the furnace wall is increased so as to form an oxidation atmosphere and increase the ash melting point, and the molten slag is prevented from attaching.

[0074] Furthermore, in accordance with the invention as recited in Claim 4, since the means for swirling the combustion air is provided so as to inject the swirling air, even in the case of enlarging the capacity of the burner, a stability of ignition, a load following ability, a shortening of flame, a lowness of soot and dust and a prevention of molten slag attachment can be achieved.

[0075] Moreover, in accordance with the invention as recited in Claim 5, the structure for freely changing the direction of the front end portion of the burner in the vertical and lateral directions is employed, the optimum position of the nozzle opening is selected in accordance with the condition, the position of the fire vortex can be changed and the distribution of the thermal load within the furnace can be adjusted.

[0076] Further, in accordance with the invention as recited in Claim 6, the burner is structured such as to have an increased width and a reduced height so as to burn a fuel at a narrow area to effect high thermal load combustion, an separately provided additional air port disposed above the burner, a twist plate disposed within a pulverized fuel pipe for biasing the pulverized fuel to an inner side of the furnace and a combustion secondary air injection port for increasing an amount of air close to the furnace wall side by increasing an opening area close to the furnace wall side, thereby the height of the entire burner is reduced so that a high thermal load combustion for burning the fuel at the narrow area is effected and the combustion air is consumed in the separately provided additional air port arranged above the burner, so that the combustion air is throttled in the burner portion so as to reduce a generation of NOx, and further the twist plate biases the pulverized fuel flowing within the pulverized fuel pipe to the inner side of the furnace, and the combustion secondary air injection port having the opening area enlarged in the portion close to the furnace wall increases the amount of the air close to the wall side of the furnace, thus, a melting point of the slag (the molten ash) is increased and the molten ash is prevented from attaching to the furnace wall in the high thermal load.

[0077] Accordingly, the pulverized coal burner in which the height of the burner is restricted, the manufacturing cost is reduced, the generation of NOx in the burner portion is reduced, the burning performance is promoted by the high thermal load combustion so as to reduce the unburned component, and the molten ash is easily taken off from the furnace wall, can be obtained, so that the apparatus having a practicality, a suitability and a high reliability can be obtained.

Claims

1. A pulverized coal burner for supplying a pulverized coal mixture in a tangential direction of an imaginary circle in a horizontal plane of a furnace so as to be burned, characterized in thalt a rich/lean separating body is arranged within a pulverized coal mixture nozzle so that said pulverized coal mixture becomes rich on a centeral side of said imaginary circle.

2. A pulverized coal burner as recited in Claim 1, characterized in thalt a mixture injecting port of a front end of said pulverized coal mixture nozzle is divided into upper and lower portions and a means for introducing an ignition promoting air is provided between the divided injecting ports.

3. A pulverized coal burner for supplying a pulverized coal mixture in a tangential direction of an imaginary circle in a horizontal plane of a furnace so as to be burned, characterized in that a pulverized coal mixture nozzle is made eccentric with respect to an air nozzle so that said pulverized coal mixture

becomes rich on a centeral side of said imaginary circle.

4. A pulverized coal burner as recited in Claim 3, characterized in that a means for applying a swirl to a combustion air supplied from an outer periphery of said pulverized coal mixture nozzle is provided.

5. A pulverized coal burner as recited in Claim 4, characterized in that a means for directing a front end portion of the burner in vertical and lateral directions is provided.

6. A pulverized coal burner, characterized in comprising a burner having an increased width and a reduced height so as to effect a high thermal load combustion of fuel in a narrow area, a separately provided additional air port disposed above said burner, a twist plate disposed within a pulverized fuel pipe for biasing a pulverized fuel to an inner side of a furnace and a combustion secondary air injection port for increasing an amount of air close to a furnace wall side by increasing an opening area close to the furnace wall side.

Fig. 1

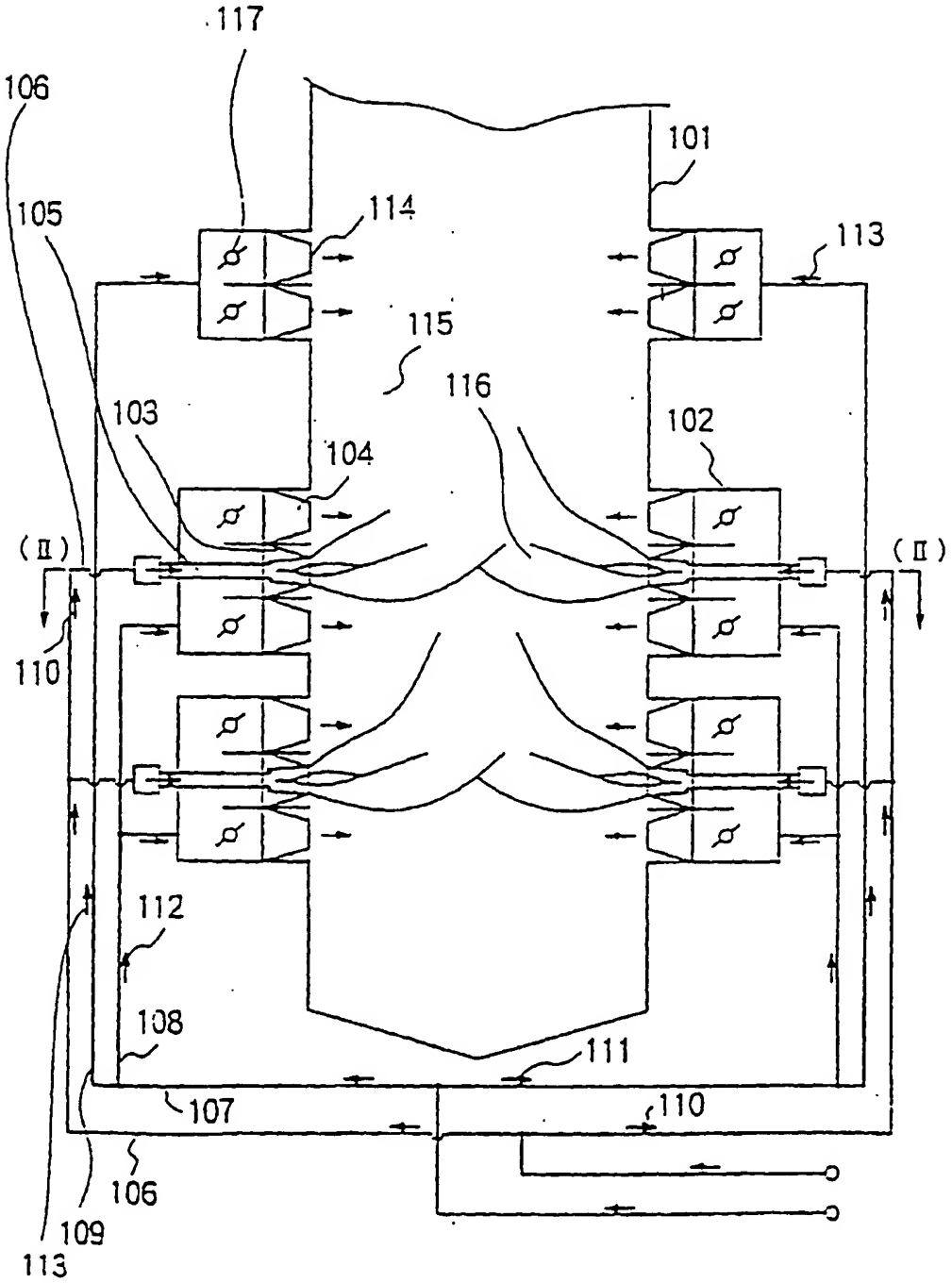
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Fig. 2

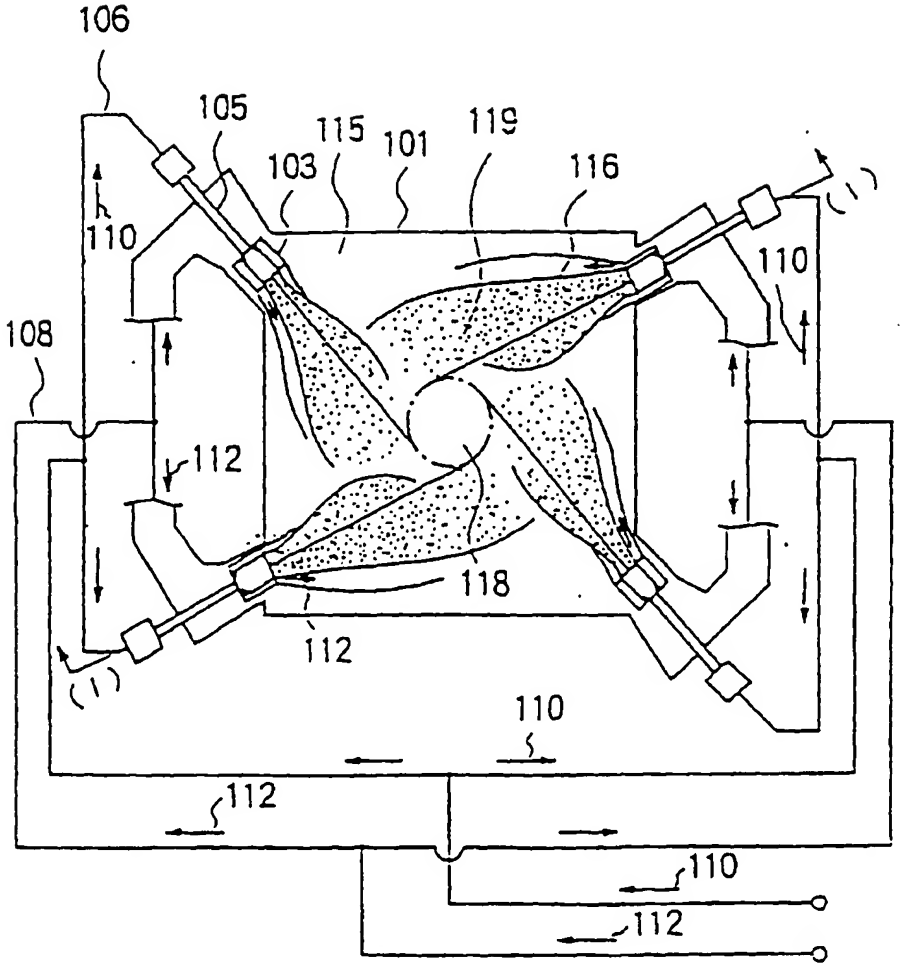
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Fig. 3(a)

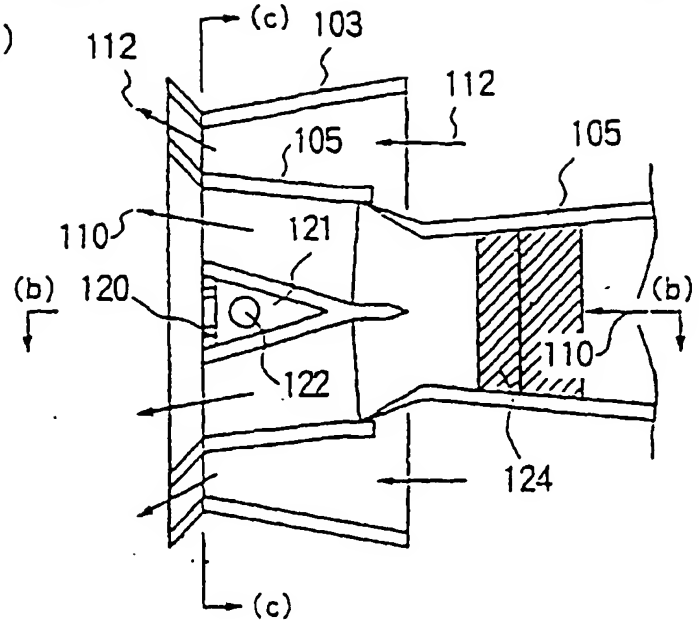


Fig. 3(b)

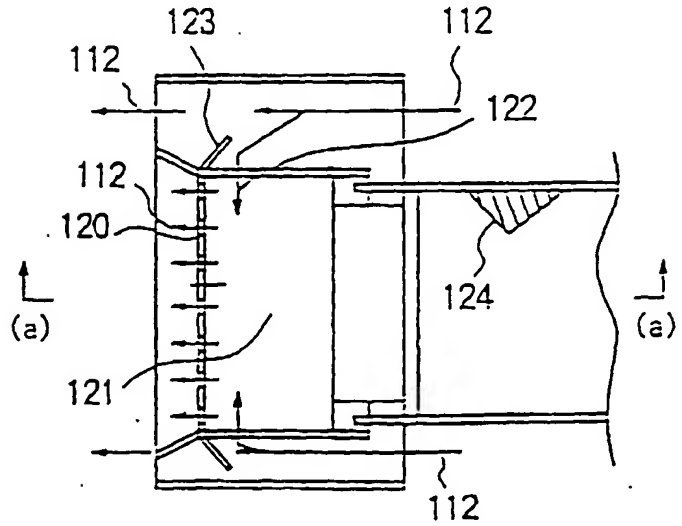
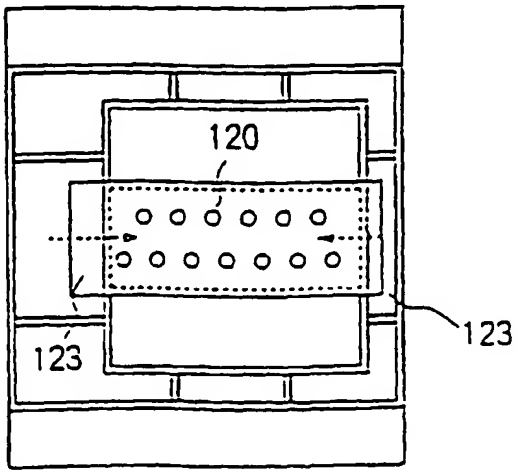


Fig. 3(c)



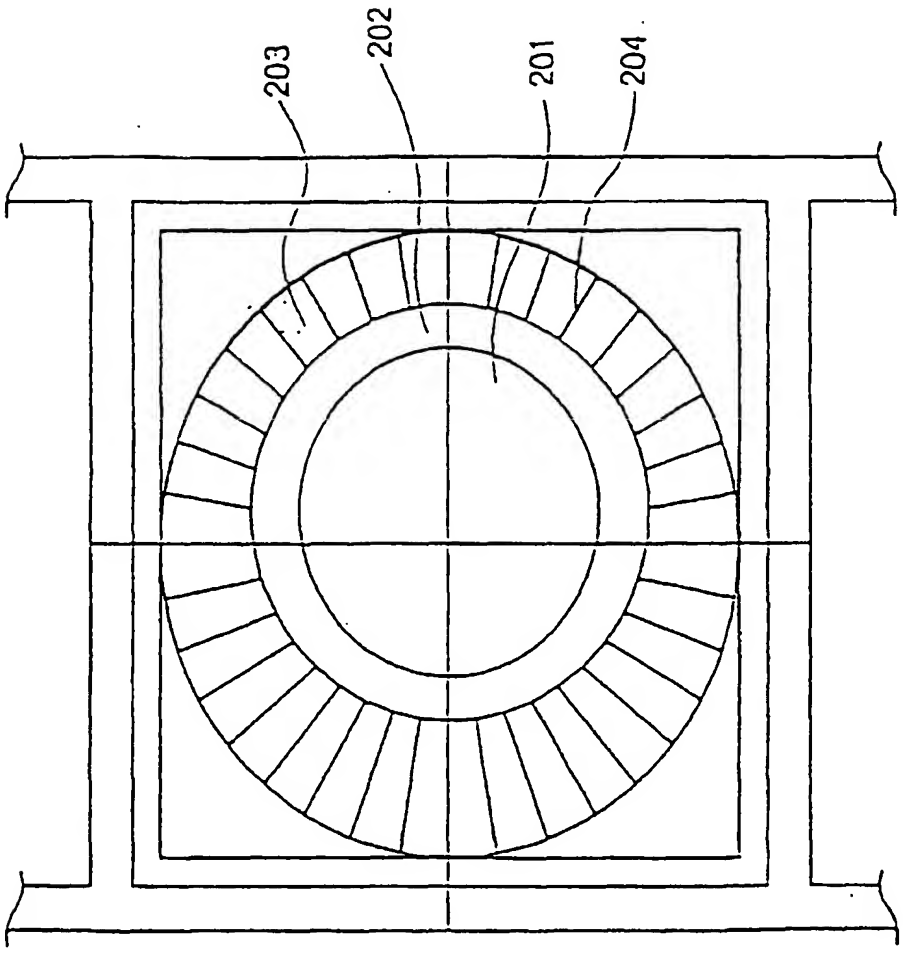


Fig. 4

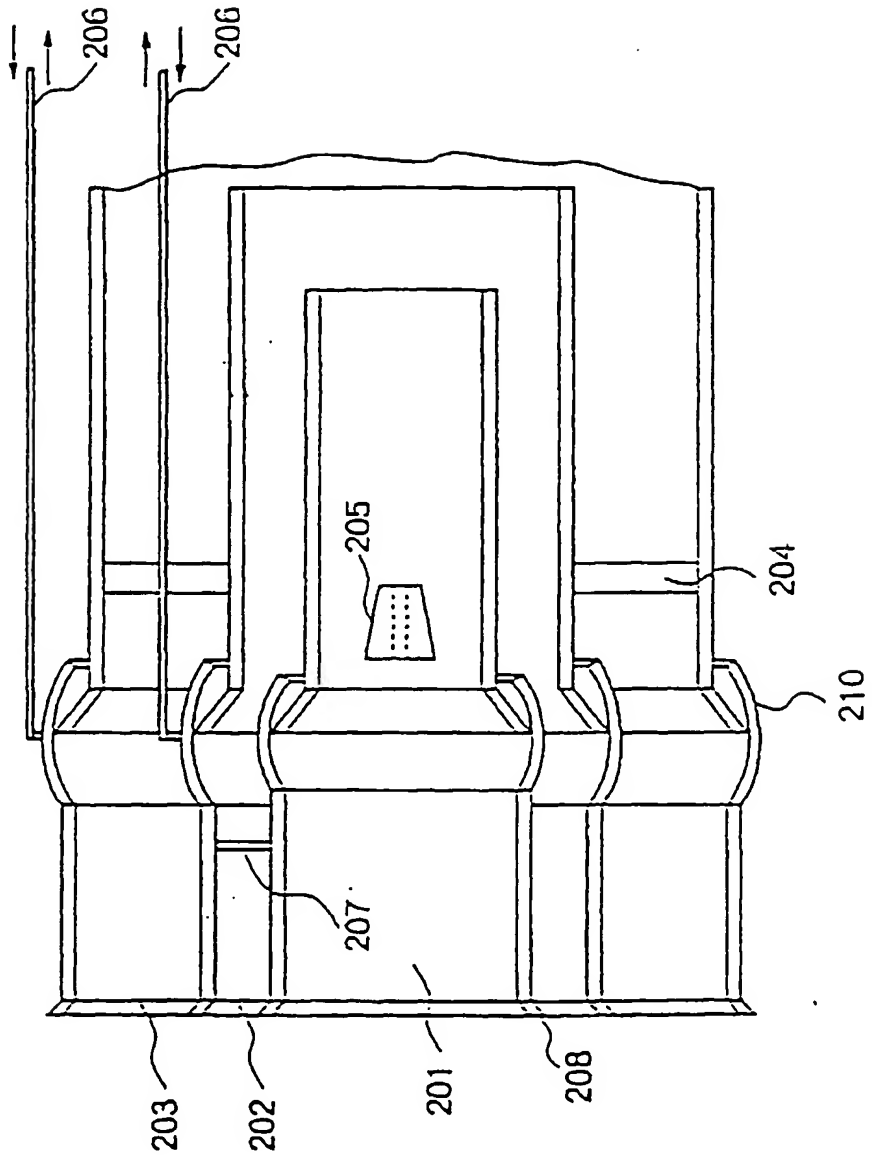


Fig. 5

Fig. 6(a)

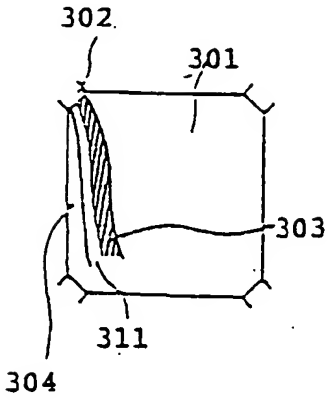


Fig. 6(b)

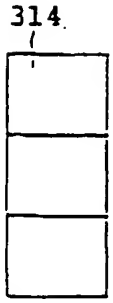
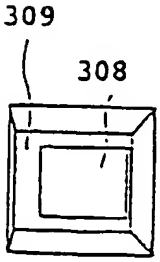


Fig. 6(c)



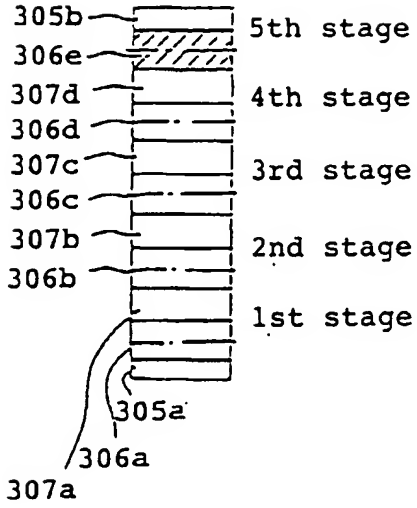
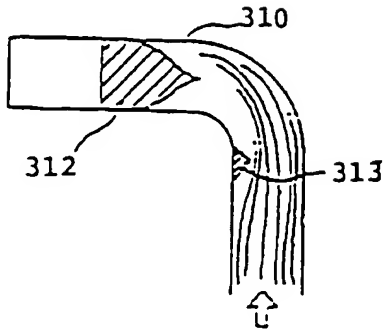


Fig. 6(d)



Pulverized Fuel and
Carrying Air

Fig. 7

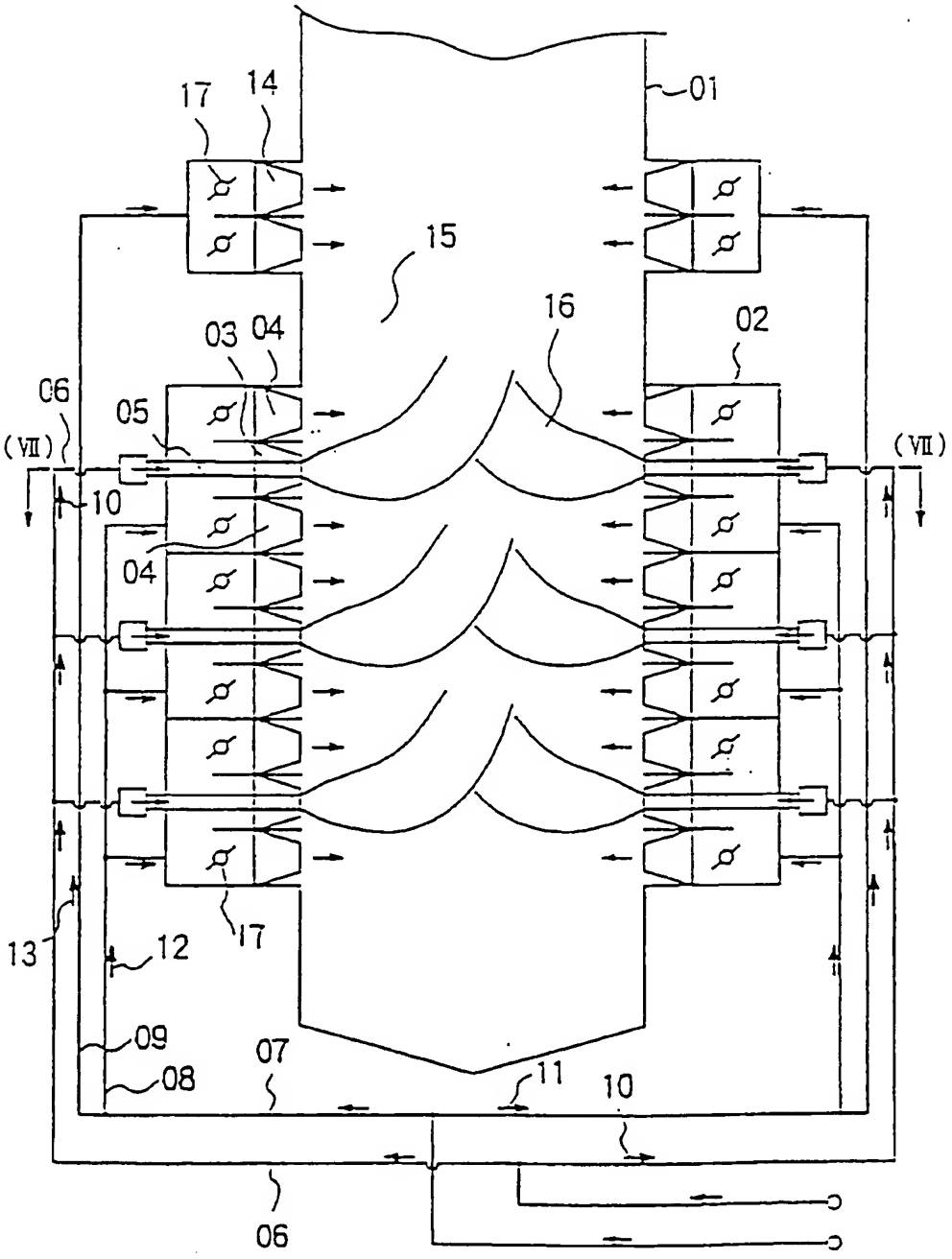


Fig. 8

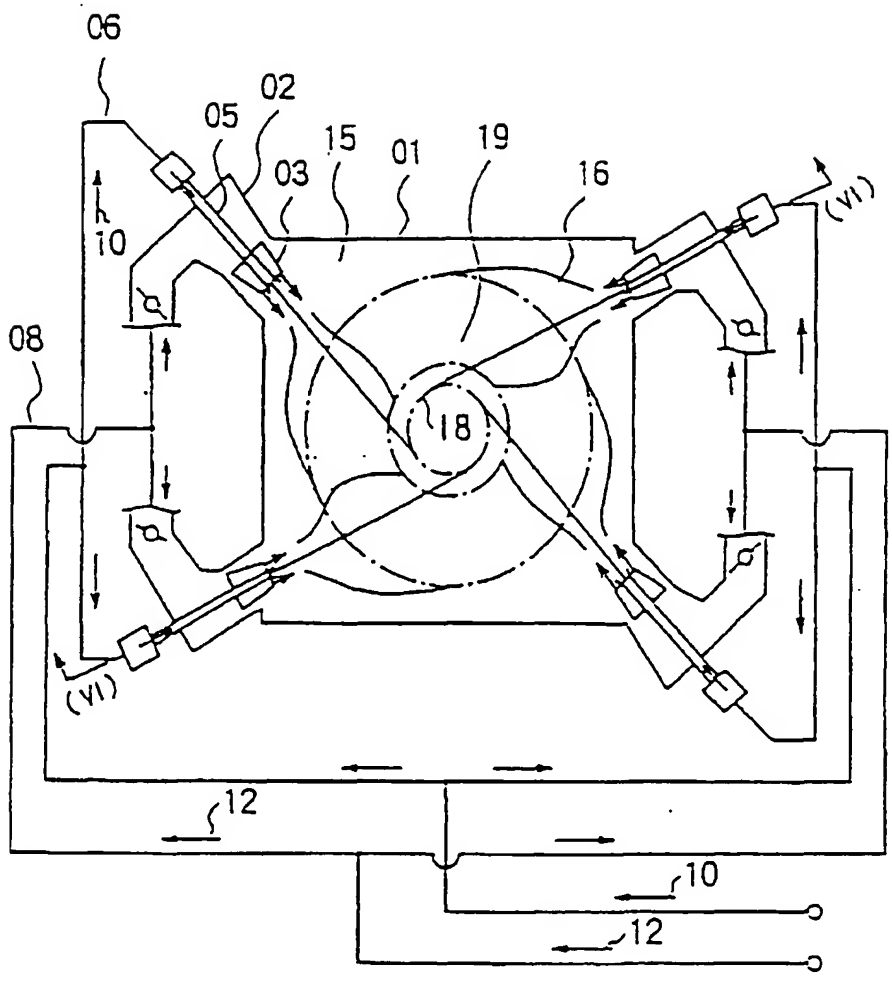


Fig. 9(a)

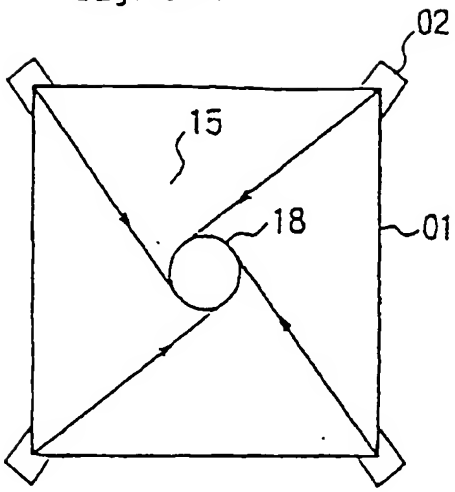


Fig. 9(b)

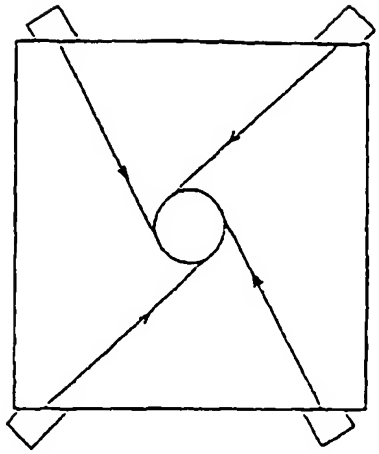


Fig. 9(c)

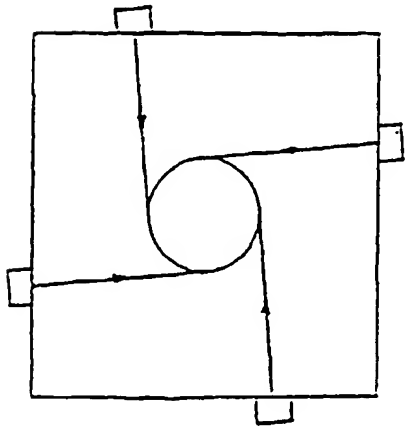


Fig. 9(d)

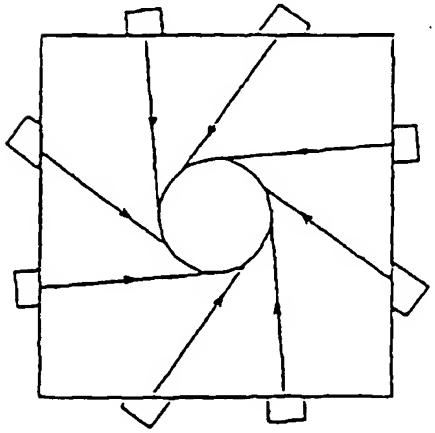


Fig. 10(a)

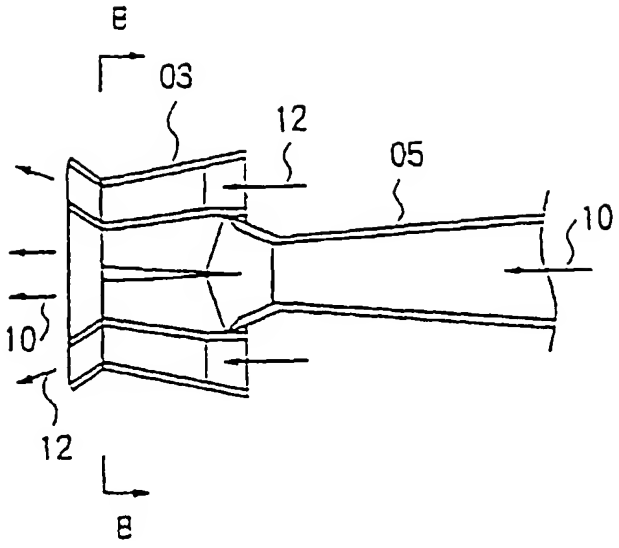
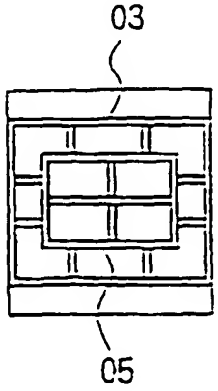


Fig. 10(b)



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 11 4219

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	PATENT ABSTRACTS OF JAPAN vol. 007, no. 244 (M-252), 28 October 1983 & JP 58 129105 A (MITSUBISHI JUKOGYO KK), 2 August 1983 * abstract *	1	F23C5/32 F23D1/00
X	PATENT ABSTRACTS OF JAPAN vol. 096, no. 011, 29 November 1996 -& JP 08 178210 A (MITSUBISHI HEAVY IND LTD), 12 July 1996 * abstract; figures 3,4 *	1	
X	EP 0 405 294 A (BALCKE DUERR AG) 2 January 1991 * column 2, line 45 - column 3, line 35; figure 1 *	3	
X	US 5 593 298 A (HURLEY JOHN F ET AL) 14 January 1997 * column 4, line 34 - line 41; figure 5 *	3	
A	US 5 315 939 A (LAFLESH RICHARD C ET AL) 31 May 1994 * column 15, line 66 - column 16, line 45; figure 5 *	3	TECHNICAL FIELDS SEARCHED (Int.Cl.6) F23D F23C
A	US 5 329 866 A (LARUE ALBERT D) 19 July 1994 * abstract; figures 1,2 *	3	
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~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 December 1998	COLI, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

European Patent Office

Application Number
EP 98 11 4219

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1,3-6

European Patent Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 98 11 4219

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1 3-6

   A pulverized coal burner provided with means for making the pulverized coal primary air mixture richer on the central side of the tangentially fired furnace

2. Claim : 2

   A pulverized coal burner provided with means for making the pulverized coal primary air mixture richer on the central side of the tangentially fired furnace

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 11 4219

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report
The members are as contained in the European Patent Office EDP file on
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